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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Teresa Grocela Rocha et al.	§	Group Art Unit: 1754
Serial No.: 10/743,646	§	Examiner: Strickland, Jonas N
Filed: December 22, 2003	§	
For: CATALYST SYSTEM AND METHOD FOR THE REDUCTION OF NOx	§	Atty. Docket: 129438-1/YOD GERD:0608

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37 C.F.R. 1.8

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May 15, 2006
Date

Lynda Howell

APPEAL BRIEF PURSUANT TO 37 C.F.R. §§ 41.31 AND 41.37

This Appeal Brief is being filed in furtherance to the Notice of Appeal mailed on February 16, 2006, and received by the Patent Office on February 22, 2006. Pursuant to a Request for Panel Review filed with the Notice, A Notice of Panel Decision was mailed by the Office on April 20, 2006. The present Brief, then, is due by May 20, 2006.

The Commissioner is authorized to charge the requisite fee of $500.00, and any additional fees which may be necessary to advance prosecution of the present application, to Account No. 07-0868, Order No. 129438-1/YOD (GERD:0608).

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1. REAL PARTY IN INTEREST

The real party in interest is General Electric Company, the Assignee of the above-referenced application by virtue of the Assignment to General Electric Company by Grocela Rocha Teresa, Male Jonathan Lloyd, Redline Jennifer Kathleen, Palmatier Alison Liana, Chen Kaidong, Hancu Dan, Soloveichik Grigorii Lev, Budesheim Eric and Simon Aaron Joseph, recorded at reel 016354, frame 0398, and dated August 4, 2005. Accordingly, General Electric Company, as the parent company of the Assignee of the above-referenced application, will be directly affected by the Board's decision in the pending appeal.

2. RELATED APPEALS AND INTERFERENCES

Appellants are unaware of any other appeals or interferences related to this Appeal. The undersigned is Appellants' legal representative in this Appeal.

3. STATUS OF CLAIMS

Claims 1-15, 24 and 25 are currently pending, are currently under final rejection and, thus, are the subject of this Appeal.

4. STATUS OF AMENDMENTS

As the claims on appeal have not been amended at any time, there are no outstanding amendments to be considered by the Board.

5. SUMMARY OF CLAIMED SUBJECT MATTER

The present invention relates generally to the field of a catalyst system and method for the reduction of nitrogen oxide emissions. *See,* Application page 1, paragraph 1. More particularly, the disclosed catalyst system includes a multi-component catalyst and reductant. *See, id.*

The Application contains two independent claims, namely, claims 1 and 15, both of which are the subject of this Appeal. The subject matter of these claims is summarized below.

With regard to the aspect of the invention set forth in independent claim 1, discussions of the recited features of claim 1 can be found at least in the below cited locations of the specification. By way of example, a catalyst system for the selective reduction of NOx comprises a catalyst and a reductant according to exemplary embodiments of the invention. The catalyst comprises a metal oxide catalyst support, a catalytic metal oxide, and a promoting metal. The reductant comprises a fluid hydrocarbon having at least 4 carbon atoms. *See, e.g.*, *id.,* page 2, paragraph 10. The catalyst also comprises a catalytic metal oxide. The catalytic metal oxide comprises gallium oxide, indium oxide, or a mixture of the two. The catalyst comprises about 5 to about 31 mol% catalytic metal oxide. *See, e.g., id.*, page 3, paragraph 12. The catalyst also comprises a promoting metal. The promoting metal may comprise any one of cobalt, silver, vanadium, molybdenum, tungsten, zinc, tin, or bismuth. The catalyst typically comprises about 0.5 to about 9 mol% of the promoting metal. *See, e.g., id.*, page 3, paragraph 13.

With regard to the aspect of the invention set forth in independent claim 15, discussions of the recited features of claim 15 can be found at least in the below cited locations of the specification. By way of example, a catalyst system for the selective reduction of NOx comprises a catalyst and a reductant according to exemplary embodiments of the invention. The catalyst comprises a metal oxide catalyst support, a catalytic metal oxide, and a promoting metal. The reductant comprises a fluid hydrocarbon having at least 4 carbon atoms. *See, e.g., id.*, page 2, paragraph 10. Typically, the metal oxide catalyst support comprises alumina. *See, e.g., id.*, page 2, paragraph 11. The catalyst also comprises a catalytic metal oxide. The catalytic metal oxide comprises gallium oxide, indium oxide, or a mixture of the two. The catalyst comprises about 5 to about 31 mol% catalytic metal oxide. *See, e.g., id.*, page 3,

paragraph 12. The catalyst also comprises a promoting metal. The promoting metal may comprise any one of cobalt, silver, vanadium, molybdenum, tungsten, zinc, tin, or bismuth. The catalyst typically comprises about 0.5 to about 9 mol% of the promoting metal. *See, e.g., id.*, page 3, paragraph 13.

A benefit of the invention, as recited in these claims, is the ability to be used in conjunction with any system in which it may be desirable to reduce NOx emissions, such as gas turbine and transportation exhaust systems, for example. The catalyst is typically placed at a location within an exhaust system where it will be exposed to effluent gas containing NOx. The catalyst may be arranged as a packed or fluidized bed reactor, coated on a monolithic or membrane structure, or arranged in any other manner within the exhaust system such that the catalyst is in contact with the effluent gas. One advantage of embodiments of the present invention is that the reduction reaction may take place in "lean" conditions. That is, the amount of reductant added to the effluent gas to reduce the NOx is generally low. The molar ratio of reductant to NOx is typically from about 0.25:1 to about 3:1. More specifically, the ratio is typically such that the ratio of carbon atoms in the reductant is about 1 to about 24 moles per one mole of NOx. Reducing the amount of reductant to convert the NOx to nitrogen may provide for a more efficient process that has decreased raw material costs.

This is a clear difference and distinction from the prior art, as discussed below.

6. <u>GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL</u>

<u>First Ground of Rejection for Review on Appeal</u>:

Appellants respectfully urge the Board to review and reverse the Examiner's first ground of rejection in which claims 1-12 and 15 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Okimura et al. (U.S. Patent 5,955,046, herein after "Okimura") in view of Park (U.S. Patent 6,706,660, hereinafter "Park") and Kepner et al. (U.S. Patent 6,342,191, hereinafter "Kepner").

Second Ground of Rejection for Review on Appeal:

Appellants respectfully urge the Board to review and reverse the Examiner's second ground of rejection in which claims 13, 14 and 24-25 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Okimura et al. (U.S. Patent 5,955,046, herein after "Okimura") in view of Park and Kepner et al. as applied to claims 1-12 and 15, and further in view of Balmer-Millar (U.S. Patent Application 2003/0118960, hereinafter "Balmer-Miller").

7. ARGUMENT

As discussed in detail below, the Examiner has improperly rejected the pending claims. Further, the Examiner has misapplied long-standing and binding legal precedents and principles in rejecting the claims under Section 103. Accordingly, Appellants respectfully request full and favorable consideration by the Board, as Appellants strongly believe that claims 1-15, 24 and 25 are currently in condition for allowance.

A. Ground of Rejection No. 1:

The Examiner rejected claims 1-12 and 15 under 35 U.S.C. § 103(a) as being unpatentable over Okimura in view of Park and Kepner.

1. Legal basis required to establish a *prima facie* case of obviousness.

The burden of establishing a *prima facie* case of obviousness falls on the Examiner. *Ex parte Wolters and Kuypers*, 214 U.S.P.Q. 735 (B.P.A.I. 1979). Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention absent some teaching or suggestion supporting the combination. *ACS Hospital Systems, Inc. v. Montefiore Hospital*, 732 F.2d 1572, 1577, 221 U.S.P.Q. 929, 933 (Fed. Cir. 1984). Accordingly, to establish a *prima facie* case, the Examiner must not only show that the combination includes all of the claimed elements, but also a convincing line of reason as to why one of ordinary skill in the art would have found the claimed invention to have been obvious in light of the teachings of the references. *Ex parte Clapp*, 227 U.S.P.Q. 972 (B.P.A.I. 1985). When prior art references require a

selected combination to render obvious a subsequent invention, there must be some reason for the combination other than the hindsight gained from the invention itself, i.e., something in the prior art as a whole must suggest the desirability, and thus the obviousness, of making the combination. *Uniroyal Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 5 U.S.P.Q.2d 1434 (Fed. Cir. 1988).

2. <u>**The Examiner's rejection of independent claims 1 and 15 is improper because the rejection fails to establish a *prima facie* case of obviousness.**</u>

Independent claim 1 recites:

> A catalyst system for the reduction of NOx in effluent gases from combustion sources comprising:
>
> a catalyst comprising
>
> a metal oxide catalyst support,
>
> a catalytic metal oxide comprising at least one of gallium oxide and indium oxide, and
>
> a promoting metal comprising at least one of silver, cobalt, vanadium, molybdenum, tungsten, zinc, tin and bismuth,
>
> wherein the catalyst comprises about 5 to about 31 mol% catalytic metal oxide and about 0.5 to about 9 mol% promoting metal; and
>
> a reductant, comprising a fluid hydrocarbon having at least 4 carbon atoms.

Independent claim 15 recites:

> A catalyst system for the reduction of NOx in effluent gases from combustion sources comprising:
>
> a catalyst comprising
>
> a metal oxide catalyst support, wherein the metal oxide catalyst support comprises alumina,
>
> a catalytic metal oxide, wherein the catalytic metal oxide is selected from the group consisting of gallium oxide, indium oxide, and combinations thereof, and

a promoting metal, wherein the promoting metal is selected from the group consisting of silver, cobalt, vanadium, molybdenum, tungsten, zinc, tin, bismuth, and combinations thereof,

wherein the catalyst comprises about 5 to about 31 mol% catalytic metal oxide and about 0.5 to about 9 mol% promoting metal; and

a reductant, comprising a fluid hydrocarbon having at least 4 carbon atoms.

a. **Okimura does not suggest catalytic metal oxides such as gallium oxide or indium oxide in the catalyst system.**

Okimura discloses a catalytic system comprising a complex oxide as the main phase. The complex oxide has a **spinel structure** and contains Al, Ga and Zn. As known in literature, metal oxides with spinel structures comprise *plurality of metals* with a very specific ratio of metal to oxygen. Okimura merely uses Ga oxides *as an ingredient* for the final product of complex oxides which form the main phase of the catalyst. Therefore, the final product of the complex oxide of the resulting spinel structure present in the catalyst system *does not include Ga oxide*. Ga oxide is merely a source for one of the multiple metals (Ga) present in the final complex oxide.

The Examiner's assertion was that the lack of a spinel structure, or any particular structure is not recited in the pending claims. Appellants submit that the Examiner has completely missed the point of the Appellants' argument. The purpose of discussing the spinel structure of Okimura was not to point out that the claims in the present application do not have spinel structure, but to understand the fundamental difference between a spinel structure as described by Okimura as the main phase in the catalyst and the *presence in the catalyst of gallium oxide* as recited in the present claims.

As known in literature, spinel structures have a cubic close packed structure with a generic formula of XY_2O_4, where X is a cation with a +2 charge and Y is a cation with a +3 charge. Due to this special atomic structure, their behavior and properties are

different than simple oxides such as gallium oxide. Appellants recognize that the starting material of the catalyst system described by Okimura has gallium oxide, but the end product of the complex oxide with a spinel structure does not include gallium oxide in the catalyst system, but specifically includes only spinel structures. That is, although gallium is present in the complex oxides described by Okimura, it is not present in the catalyst as gallium oxide but as part of the complex oxide which forms the main phase of the catalyst.

In the ternary phase diagram (shown in FIG. 1 of Okimura), the hatched portion clearly shows the operating ranges of the complex oxides described by Okimura. Any composition within the hatched region will include all three metals namely zinc, aluminum and gallium to arrive at the complex oxide of the spinel structure. Okimura discloses that:

> [w]hen the amount of ZnO becomes 50 mol% or larger, crystals having other than spinel structure will be formed, resulting in potential deterioration in catalytic activity... Col. 3, lines 7-10.

Okimura clearly teaches that the properties of the spinel structures of the complex oxides are different by keeping the compositions of Zn, Al and Ga under some specific ranges. Therefore the catalytic system described by Okimura is fundamentally different from the catalyst system claimed, and would not and could not function in a similar manner.

The Examiner noted that the claims do not specifically recite that the claimed metal oxides do not have a spinel structure. Appellants contend that the claims need not include such a recitation to clearly distinguish the invention over the cited art. Indeed, independent claims 1 and 15 recite gallium oxide, indium oxide or a combination of the two. As noted above, Okimura, which forms the basis for the rejection as regards the inclusion of the recited oxides, does not teach the use of such oxides, but rather a complex that no longer can be said to include the basic oxides at all. Claims 1 and 15

therefore need not explicitly exclude complex oxides having spinel structures, as the claims affirmatively include gallium oxide.

b. <u>Kepner and Park do not suggest the metal oxides of independent claims 1 and 15.</u>

Kepner describes a catalyst and binder system with a binder and a pendant ligand substituted or unsubstituted adsorbent. The system described by Kepner is fundamentally different from the catalyst system of the present invention. The catalyst system of the present invention does not include either a binder or an adsorbent. Even more fundamentally, Kepner does not teach the use of the oxides recited in the pending independent claims, and the Examiner did not advance that it does.

Park describes a catalyst system including an oxide support material, and a metal promoter or dopant. However, Park neither discloses nor suggests use of a hydrocarbon as a reductant comprising at least 4 carbon atoms. The use of hydrocarbon comprising higher carbon content is not suggested by any of the cited references. Here again, Park fails to teach the oxides missing from Okimura and Kepner.

Given the fact that none of the references teaches at least the use of the recited oxides, the combination of Okimura, Kepner and Park cannot suggest or teach the catalyst system of the present claims. Thus, the references cannot support a *prima facie* case of obviousness. As such, the Appellants respectfully request that the Board direct the Examiner to allow the independent claims 1 and 15 and the claims 2-11 that depend therefrom.

B. <u>Ground of Rejection No. 2</u>:

The Examiner rejected claims 13, 14 and 24-25 under 35 U.S.C. § 103(a) as being unpatentable over Okimura in view of Park and Kepner as applied to claims 1-12 and 15, and further in view of Balmer-Millar.

<u>The Examiner's rejection of dependent claims 13, 14 and 24-25 is improper because the rejection fails to establish a *prima facie* case of obviousness.</u>

Balmer-Miller describes a NO_x after-treatment system. As described by Balmer-Miller, the reductant used for NO_x reduction are oxygenated hydrocarbons derived from the fuel source. The example of the fuel source is given as gasoline. Gasoline itself is not used as the reductant, but is merely used to derive the oxygenated reductant, which is finally used in the catalyst system to reduce NO_x. Balmer-Miller neither suggests nor discloses use of hydrocarbon comprising at least 4 carbon atoms. As well-known in art, and also defined in paragraph 18 of the present application, hydrocarbons contain only carbon and hydrogen atoms. As also known in the art, the reactions of oxygenated hydrocarbons and non-oxygenated hydrocarbons are fundamentally different. However the use of gasoline, hydrocarbon containing 8 carbon atoms, and other higher hydrocarbons as recited in claims 13-14 and 24-25 is neither suggested nor disclosed by Balmer-Miller.

Indeed, the vast majority of the Examiner's rejections are based not on explicit disclosures within the cited reference but merely on the Examiner's unsupported opinion. Because there has been no showing by the Examiner that the above-recited features are present or desirable in Balmer-Miller, the modifications suggested by the Examiner are hardly obvious. Accordingly, no *prima facie* case of obviousness exists with regard to claims 13, 14 and 24-25. As such, the Appellants respectfully request that the Board direct the Examiner to allow the claims 13, 14 and 24-25.

Conclusion

Appellants respectfully submit that all pending claims are in condition for allowance. However, if the Examiner or Board wishes to resolve any other issues by way of a telephone conference, the Examiner or Board is kindly invited to contact the undersigned attorney at the telephone number indicated below.

Respectfully submitted,

Date: 5/15/2006

Patrick S. Yoder
Reg. No. 37,479
FLETCHER YODER
P.O. Box 692289
Houston, TX 77269-2289
(281) 970-4545

8. APPENDIX OF CLAIMS ON APPEAL

Listing of Claims:

1. (original) A catalyst system for the reduction of NOx in effluent gases from combustion sources comprising:

a catalyst comprising

a metal oxide catalyst support,

a catalytic metal oxide comprising at least one of gallium oxide and indium oxide, and

a promoting metal comprising at least one of silver, cobalt, vanadium, molybdenum, tungsten, zinc, tin and bismuth,

wherein the catalyst comprises about 5 to about 31 mol% catalytic metal oxide and about 0.5 to about 9 mol% promoting metal; and

a reductant, comprising a fluid hydrocarbon having at least 4 carbon atoms.

2. (original) The catalyst system of claim 1, wherein the metal oxide catalyst support comprises at least one of alumina, titania, zirconia, and ceria.

3. (original) The catalyst system of claim 1 wherein the promoting metal further comprises indium.

4. (original) The catalyst system of claim 3 wherein the catalyst comprises about 1 to about 5 mol% indium.

5. (original) The catalyst system of claim 1, wherein the catalyst comprises from about 25 to about 31 mol% gallium oxide.

6. (original) The catalyst system of claim 1, wherein the promoting metal comprises silver.

7. (original) The catalyst system of claim 6, wherein the catalyst comprises from about 1 to about 4 mol% silver.

8. (original) The catalyst system of claim 1, wherein the promoting metal comprises cobalt.

9. (original) The catalyst system of claim 8, wherein the catalyst comprises from about 1 to about 4 mol% cobalt.

10. (original) The catalyst system of claim 1, wherein the catalyst comprises from about 1 to about 5 mol% tungsten.

11. (original) The catalyst system of claim 1, wherein the catalyst comprises from about 1 to about 5 mol% molybdenum.

12. (original) The catalyst system of claim 1, wherein the catalyst comprises about 20 mol% to about 30 mol% gallium oxide and about 1 mol% to about 4 mol% indium oxide.

13. (original) The catalyst system of claim 1, wherein the reductant is gasoline.

14. (original) The catalyst system of claim 1, wherein the reductant comprises a hydrocarbon having eight carbon atoms.

15. (original) A catalyst system for the reduction of NOx in effluent gases from combustion sources comprising:

a catalyst comprising

a metal oxide catalyst support, wherein the metal oxide catalyst support comprises alumina,

a catalytic metal oxide, wherein the catalytic metal oxide is selected from the group consisting of gallium oxide, indium oxide, and combinations thereof, and

a promoting metal, wherein the promoting metal is selected from the group consisting of silver, cobalt, vanadium, molybdenum, tungsten, zinc, tin, bismuth, and combinations thereof,

wherein the catalyst comprises about 5 to about 31 mol% catalytic metal oxide and about 0.5 to about 9 mol% promoting metal; and

a reductant, comprising a fluid hydrocarbon having at least 4 carbon atoms.

16. (withdrawn) A method for reducing NOx from an effluent gas comprising:

mixing a NOx containing effluent gas with a fluid hydrocarbon reductant comprising at least carbon atoms to create a gas mixture; and

passing the gas mixture through a catalyst, wherein the catalyst comprises

a metal oxide catalyst support,

a catalytic metal oxide comprising at least one of gallium oxide and indium oxide,

a promoting metal comprising at least one of silver, cobalt, vanadium, molybdenum, tungsten, zinc, tin and bismuth,

wherein the catalyst comprises about 5 to about 31 mol% catalytic metal oxide and about 0.5 to about 9 mol% promoting metal.

17. (withdrawn) The method of claim 16, wherein the reductant and the NOx are present in a C:NOx molar ratio from about 1:1 to about 24:1.

18. (withdrawn) The method of claim 16, wherein the reductant comprises gasoline.

19. (withdrawn) The method of claim 16, wherein the reductant comprises a hydrocarbon having eight carbon atoms.

20. (withdrawn) The method of claim 16, wherein the gas mixture further comprises at least 1.0 % water by volume.

21. (withdrawn) The method of claim 20, wherein the gas mixture comprises about 7 to about 9 % water by volume.

22. (canceled).

23. (canceled).

24. (previously presented) The catalyst system of claim 1, wherein the reductant is selected from the group consisting of pentane, hexane, octane, 1-octene, trimethyl pentane, cyclooctane and 1, 3-dimethyl-cyclohexane.

25. (previously presented) The catalyst system of claim 15, wherein the reductant is selected from the group consisting of pentane, hexane, octane, 1-octene, trimethyl pentane, cyclooctane and 1, 3-dimethyl-cyclohexane.

9. APPENDIX OF EVIDENCE

None.

10. APPENDIX OF RELATED PROCEEDINGS

None.